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Attorney's Docket No.: 08935-244001 / M-4961

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant	: Jane A. Blasi et al.	Art Unit	: 1745
Serial No.	: 10/022,289	Examiner	: Dah-Wei D. Yuan
Filed	: December 14, 2001		
Title	: ELECTROLYTE ADDITIVE FOR NON-AQUEOUS ELECTROCHEMICAL CELLS		

Mail Stop Appeal Brief - Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

BRIEF ON APPEAL

Applicants are appealing the final rejection of claims 19-26, 31, 32, and 34-36 in the Office Action dated February 27, 2004. Applicants request that the rejection be reversed. A notice of appeal was filed on May 26, 2004.

I. Real Party in Interest

The real party in interest is The Gillette Company, Prudential Tower Building, Boston, Massachusetts.

II. Related Appeals and Interferences

There are no related appeals or interferences.

III. Status of Claims

Claims 19-26 and 34-36 stand rejected under 35 U.S.C. § 103(a) over Nimon et al., US. Patent No. 6,165,644 ("Nimon") in view of Kim et al., U.S. Patent No. 6,011,509 ("Kim").

CERTIFICATE OF MAILING BY FIRST CLASS MAIL

I hereby certify under 37 CFR §1.8(a) that this correspondence is being deposited with the United States Postal Service as first class mail with sufficient postage on the date indicated below and is addressed to the Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

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Claims 31 and 32 stand rejected under 35 U.S.C. § 103(a) over Nimon in view of Kim and further in view of Kitoh et al., U.S. Patent No. 6,352,793 ("Kitoh").

IV. Status of Amendments

All amendments have been entered.

V. Summary of Invention

The invention relates to an electrochemical cell with a component that is made from aluminum or an aluminum-based alloy and an electrolyte including lithium perchlorate and another lithium salt. Claim 19 covers this cell and reads as follows:

> 19. An electrochemical cell comprising a cathode containing an aluminum current collector, an anode, and an electrolyte containing lithium perchlorate and a lithium salt selected from the group consisting of LiTFS, LiTFSI, and $LiPF_6$, wherein the cell is a primary electrochemical cell.

Applicants have found that the lithium perchlorate helps to protect the aluminum or aluminum-based alloy component from corrosion. (See, e.g., Application, page 5, lines 16-17.) As a result, the component can be used in the cell, which is advantageous for a number of reasons. First, aluminum is lighter than some of the other materials (e.g., stainless steel) that can be used for electrochemical cell components. (See id., page 2.) Thus, a cell that includes one or more aluminum or aluminum-based alloy components can be relatively light. (See id.) Second, aluminum is very conductive, and its use in a cell can cause the cell to have low ohmic resistance under polarization. (Id.) Third, aluminum is less expensive than some other materials, such as stainless steel, that can be used in electrochemical cell components. (Id.)

VI. Issues

Have the claims been properly rejected under 35 U.S.C. § 103(a) over the combination of references listed in Status of Claims (above)?

VII. Grouping of Claims

The claims stand or fall together.

Applicants have made this grouping to simplify the issues on appeal. A particular claim in the group may be patentable for other reasons that do not apply to the entire group. Applicants preserve the right to present further arguments with respect to each claim in subsequent proceedings before the Patent and Trademark Office or in subsequent litigation.

VIII. Argument

A. Claims 19-26, 31, 32, and 34-36

In rejecting claims 19-26, 31, 32, and 34-36, the Examiner cited Nimon, which describes lithium-sulfur batteries with sulfur cathodes. (See, e.g., Nimon, col. 9, line 6 — col. 12, line 2.) According to Nimon, sulfur cathodes are advantageous because they can enhance the energy densities and cycling performance of batteries. (See, e.g., id., col. 1, lines 52-64.) Nimon explains that his sulfur cathodes produce polysulfides and/or sulfides during use:

> At some state of discharge, the positive electrode will include one or more polysulfides and possibly sulfides, which are polysulfides and sulfides of the metal or metals found in the negative electrode. In some embodiments, the fully charged electrode may also include some amount of such sulfides and/or polysulfides. (Id., col. 9, lines 14-19.)

Nimon notes that, in embodiments in which his battery includes a liquid electrolyte, it is preferable that the electrolyte "solubilize lithium sulfide and relatively low molecular weight polysulfides", in order to keep these "sulfur discharge products in solution and therefore available for electrochemical reaction." (See id., col. 9, lines 40-45.)

While sulfur cathodes can be advantageous for use in a lithium battery, they also can have some disadvantages. As Nimon explains,

> [T]he cycling efficiency of lithium-sulfur batteries is limited by the slow degradation of the lithium electrode surface arising from the formation of dendritic and/or high surface area 'mossy lithium' — lithium-sulfur complexes that are detached from the lithium electrode and float freely in the electrolyte. (Id., col. 1, line 67 — col. 2, line 5.)

Nimon tries to address this problem by providing various methods of protecting the lithium electrode. (See, e.g., id., col. 2, line 29 — col. 3, line 11.) One of Nimon's methods entails adding a salt of a lithium-alloy forming multivalent metal to a polysulfide-containing battery electrolyte. (See, e.g., id., col. 5, lines 8-11.) Because this lithium-alloy forming metal is

multivalent and forms an alloy with lithium, it clearly is not lithium. As Nimon explains, it is believed that the multivalent metal alloys with lithium, thereby forming a protective film over the lithium anode:

> Without wishing to be bound by any theory, it is believed that addition of Me salts [salts of transition- or alkaline earth metals] leads to an electrochemical deposition of these Me on the surface of Li and possibly the formation of thin layers of Li-Me alloys. On the surface of [the] electrode Li is incorporated into the matrix and is thus protected from the reaction with strongly oxidizing polysulfides of the counter electrode. As a result, the plating of dendritic lithium or loss of lithium to the electrolyte solution (e.g., as Li_2S_8) is suppressed or slowed. (Id., col. 5, lines 44-52.)

In Section 6.2 of his application, Nimon describes an experiment (Experiment 2) in which he tested one of the above-described electrolytes. The electrolyte of Experiment 2 included Li_2S_8 (the polysulfide) and $Mg(ClO_4)_2$ (the salt of a lithium-alloy forming metal). (See id., col. 13, lines 5-21.) Nimon explains that Experiment 2 showed that "cells including 0.5 moles/liter $Mg(ClO_4)_2$ ran for 50 cycles before [lithium] stripping as compared to non-augmented cells that ran for only 32 cycles before stripping . . . ." (Id., col. 5, lines 33-36.) Thus, the addition of $Mg(ClO_4)_2$ to the electrolyte appears to have provided some protection to the lithium anode.

Aside from including a polysulfide and a salt of a lithium-alloy forming multivalent metal, the battery may further include another electrolyte salt, of which Nimon provides several lithium-based examples:

> Exemplary but optional electrolyte salts for the battery cells incorporating the electrolyte solvents of this invention include, for example, [LiTFSI], [LiTFS], lithium perchlorate ($LiClO_4$), $LiPF_6$, $LiBF_4$, and $LiAsF_6$ . . . . (Id., col. 10, lines 13-17.)

For example, the electrolyte of Nimon's Experiment 2, in addition to including Li_2S_8 and $Mg(ClO_4)_2$, further included LiTFSI. (See id., col. 13, lines 5-9.) Nimon explains that this other electrolyte salt is optional because the sulfur electrode, during use, already forms electrolyte salts:

> As indicated above, the electrolyte salt is optional for the battery cells of this invention, in that upon discharge of the battery, the metal sulfides or polysulfides formed can act as electrolyte salts, for example, $M_{x/z}S$ wherein x=0 to 2 and z is the valence of the metal. (Id., col. 10, lines 20-24, emphasis added.)

A person of ordinary skill in the art, upon reading Nimon, would not be motivated to use an electrolyte that includes multiple lithium salts selected from Nimon's list of optional electrolyte salts. First, and as explained above, the exemplary lithium salts are optional, because the function that they would serve is already provided by polysulfide and/or sulfide salts formed by the sulfur cathode. Second, even if a person of ordinary skill in the art were to use a lithium electrolyte salt from the optional salt list, Nimon teaches adding only one salt from the list, as indicated by Nimon's statement that the "electrolyte salt is optional". Furthermore, with the addition of even one of the optional lithium salts to the above-described electrolyte, the electrolyte would already include at least two or three electrolyte salts (i.e., the polysulfide and/or sulfide salts, the optional lithium salt, and in some embodiments, the salt of a lithium-alloy forming multivalent metal). Nimon does not provide any particular reason for adding yet another lithium salt into the electrolyte at this point, and a person of ordinary skill in the art would not be motivated to do so.

In his Advisory Action, the Examiner argued that:

> Nimon et al. disclose an electrolytic solution comprising lithium ions, trifluoromethanesulfonimide ions and perchlorate ions, which encompass the ionic species as recited in claim 19. See Column 13, Lines 5-10. (May 11, 2004 Advisory Action, page 2.)

The section of Nimon to which the Examiner referred is the description of Experiment 2. The Examiner apparently thinks that Experiment 2 renders claims 19-26 and 31, 32, and 34-36 obvious by describing the same ionic species (i.e., lithium ions, trifluoromethanesulfonimide ions and perchlorate ions) that would be present in an electrolyte covered by the claims. But the claims specifically recite lithium perchlorate, and Experiment 2, as discussed above, exemplifies the use of non-lithium-containing perchlorate compounds, such as magnesium perchlorate, as electrolyte salts. As explained above, the magnesium perchlorate in Nimon is added to the electrolyte to provide protection for the lithium anode. There is no indication in Nimon that a lithium salt would serve this same function. The presence of perchlorate ions in Experiment 2, therefore, does not suggest the use of lithium perchlorate in the electrolyte. The only salt in Experiment 2 that is a member of Nimon's list of exemplary optional salts is LiTFSI. Thus,

Experiment 2 does not support the Examiner's position that Nimon teaches or suggests adding more than one of the optional salts into the electrolyte.

The Examiner's arbitrary selection of multiple lithium salts out of Nimon's list of optional electrolyte salts is contrary to Nimon's teaching that using even one of these electrolyte salts is not necessary, and is a clear hindsight reconstruction of Applicants' invention.

IX. Conclusion

For the above reasons, Applicants respectfully request that the 35 U.S.C. § 103(a) rejections of claims 19-26, 31, 32, and 34-36 be reversed.

The brief fee of $330 is enclosed. Please apply any other charges or credits to Deposit Account No. 06-1050.

Respectfully submitted,

Date: JULY 26, 2004

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Appendix of Claims

19. An electrochemical cell comprising a cathode containing an aluminum current collector, an anode, and an electrolyte containing lithium perchlorate and a lithium salt selected from the group consisting of LiTFS, LiTFSI, and $LiPF_6$, wherein the cell is a primary electrochemical cell.

20. The cell of claim 19, wherein the cathode contains MnO_2.

21. The cell of claim 19, wherein the anode contains lithium.

22. The cell of claim 19, wherein the electrolyte contains at least 500 ppm by weight of the lithium perchlorate.

23. The cell of claim 19, wherein the electrolyte contains at least 1000 ppm by weight of the lithium perchlorate.

24. The cell of claim 19, wherein the electrolyte contains at least 1500 ppm by weight of the lithium perchlorate.

25. The cell of claim 19, wherein the electrolyte contains at least 2500 ppm by weight of the lithium perchlorate.

26. The cell of claim 19, wherein the electrolyte contains less than 20,000 ppm by weight of the lithium perchlorate.

31. The cell of claim 19, wherein the cell includes a case comprising aluminum.

32. The cell of claim 31, wherein the case consists essentially of aluminum.

34. The cell of claim 19, wherein the electrolyte contains at least 5000 ppm by weight $LiPF_6$.

35. The cell of claim 34, wherein the electrolyte contains at least 10,000 ppm by weight $LiPF_6$.

36. The cell of claim 19, wherein the electrolyte is essentially free of $LiPF_6$.